

September 27, 2011



HGM Associates, Inc.
640 5th Avenue
Council Bluffs, Iowa 51502

Attention: Mr. Terry Smith, P.E.

Re: Geotechnical Report Addendum No. 2
Revised Global Stability Analyses
South Ash Containment Pond Embankments
Riverside Generating Station
Bettendorf, Iowa
Terracon Project No. 07105081/02105081G

Dear Mr. Smith,

As requested, Terracon Consultants Inc. (Terracon) has conducted additional subsurface exploration and revised our global stability analyses of the South Ash Containment Pond Embankments to evaluate meeting a minimum factor of safety of 1.5 under Steady State Seepage conditions as required by USACE embankment dam criteria. This addendum letter summarizes the results of our additional exploration and analysis of the current embankment slopes. Logs of the supplemental borings and a revised location plan are included with this addendum letter.

Our December 7, 2010 geotechnical report for the project indicated the global stability factor of safety of the embankments under conditions of Steady State Seepage ranged from 1.42 to 1.51 for the five (5) sections analyzed. The borings performed for our original analysis did not extend into the 1968 embankment and access to perform borings to intercept the 1968 embankment was not available at that time. For this reason, the geometry and material properties of the original 1968 construction were estimated from limited historical drawings and MEC construction cost estimate data available. Based on the limited information, our analyses included conservative estimates of the geometry and material characteristics for the original 1968 embankment construction located within and beneath the toe of the existing embankments (refer to Sections 3.2, 3.4 and 3.7 of our December 7, 2010 report). Estimates of the original river alluvium properties and thicknesses beneath the 1968 embankment were also made for our analysis.

To help obtain a better understanding of the 1968 embankment and underlying alluvium, four (4) supplemental borings were performed during the remediation project for the South Ash Containment Pond Embankment project. The supplemental borings indicate the original 1968 embankment extended deeper than originally estimated with little to no native river bed alluvium present beneath the embankment section. The additional information obtained from the supplemental borings was used to update the slope stability cross-sections for our revised



analysis. The materials encountered in this zone consisted of a mixture of riprap, gravel, sand, silt, and ash. We assigned a friction angle of 36 degrees to this zone, labeled 1968 Levee Foundation, in our analysis.

Using the updated cross-sections, our revised analyses for the referenced sections indicate the factor of safety under Steady State Seepage conditions ranges from 1.50 to 1.57 at the five (5) design sections, shown in the following table. These values meet and/or exceed the minimum required factor of safety of 1.5 required for embankment dam safety criteria for the Steady State Seepage condition. Based on our revised analysis, it is our opinion that no additional remediation of the embankment sections beyond that which has been completed to date appears necessary.

Section	Estimated Factor of Safety Obtained from Steady State Seepage Analysis ¹	
	Required Minimum Factor of Safety ²	Downstream
A	1.5	1.51
B	1.5	1.53
C	1.5	1.57
D	1.5	1.53
E	1.5	1.50

1. Reported factors of safety are for deep seated circular "failure" surfaces that emerge near the levee crest. Computed factors of safety for shallow circular "failure" surfaces near the toe of the levee may be smaller.
2. Reference: Table 6.1b from EM 1110-2-1913

The analysis and recommendations presented in this addendum are based upon the data obtained from the borings performed at the indicated locations and from other information discussed in this report. This addendum is intended to supplement the original Geotechnical Engineering Report prepared for this project and is not intended to be used separately from the original report. This addendum and the recommendations contained herein are considered part of, and should be attached to, our geotechnical report for the project. The recommendations, opinions and limitations contained in the original geotechnical report and subsequent addenda that are not specifically addressed in this addendum remain valid.

This addendum has been prepared for the exclusive use of our client for specific application to the project discussed and has been prepared in accordance with generally accepted geotechnical engineering practices. No warranties, either expressed or implied, are intended or made. In the event changes in the nature, design, or location of the project as outlined in this addendum, are planned, the conclusions and recommendations contained in this addendum

shall not be considered valid unless Terracon reviews the changes, and either verifies or modifies the conclusions of this addendum in writing.

We appreciate the opportunity to be of further service to you on this project. If you have any questions regarding this letter, please contact us.

Sincerely,

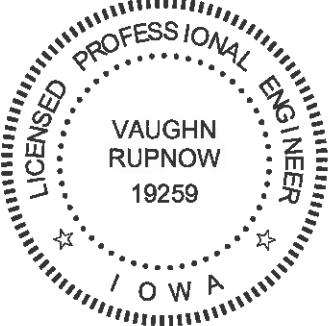
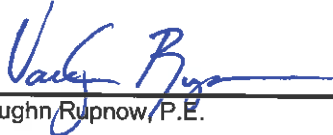
Terracon Consultants, Inc.



For Steven M. Leverson, Ph.D., P.E.
Senior Consultant



Vaughn Rupnow, P.E.
Iowa No. 19259

	<p>I hereby certify that this engineering document was prepared by me or under my direct personal supervision and that I am a duly licensed Professional Engineer under the laws of the State of Iowa.</p> <p> Vaughn Rupnow, P.E.</p> <p><u>9/27/2011</u> Date</p> <p>My license renewal date is December 31, 2012.</p>
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Attachments



LEGEND



APPROXIMATE BORING LOCATION

THIS DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

NOT TO SCALE

Project Mgr: WKB Drawn By: DWD Checked By: WKB/MRF Approved By: WKB	Project No. 07105081 Scale: AS SHOWN File No. GEOG108061-1 Date: NOV. 2010	 Consulting Engineers and Scientists 370 40th Avenue Bettendorf, Iowa 52722 (563) 366-0702 (563) 366-4788	BORING LOCATION SKETCH SOUTH ASH CONTAINMENT POND RIVERSIDE GENERATING STATION BETTENDORF, IOWA	EXHIBIT A-1
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LOG OF BORING NO. 12

Page 1 of 1

CLIENT		HGM Associates, Inc.	
SITE		Riverside Generating Station Bettendorf, Iowa	
PROJECT		Ash Containment Ponds - South Pond	
GRAPHIC LOG	Boring Location: Station 7+55	DEPTH, ft.	USCS SYMBOL
	DESCRIPTION		
	Approx. Surface Elev.: 564 ft		
	FILL, MIXTURE OF RIPRAP, GRAVEL, SAND, SILT, AND ASH Dark brown		DH
		5	
		10	
14	550		
	SILTY SAND Dark Gray	15	
16	548		
	WEATHERED SANDY SHALE*** Gray	20	
		24	
	540		
	BOTTOM OF BORING		
***Classification of rock materials has been estimated by the drill crew based on disturbed samples. Core samples and petrographic analysis may reveal other rock types.			

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

*Pocket Penetrometer
**CME 140 lb. SPT automatic hammer

WATER LEVEL OBSERVATIONS, ft

WL	2	WD	
WL		WD	
WL		WD	

Terracon

BORING STARTED	7-26-11
BORING COMPLETED	7-26-11
RIG	750
FOREMAN	JT
APPROVED	VER
JOB #	07105081

BOREHOLE BORING LOGS SOUTH POND.GPJ 2011 TULSA.GDT 9/27/11

LOG OF BORING NO. 13

Page 1 of 1

CLIENT

HGM Associates, Inc.

SITE

Riverside Generating Station
Bettendorf, Iowa

PROJECT

Ash Containment Ponds - South Pond

Boring Location: Station 1+25

GRAPHIC LOG

DESCRIPTION

Approx. Surface Elev.: 564 ft

DEPTH, ft.

USCS SYMBOL

NUMBER

TYPE

RECOVERY, in.

SPT-N
BLOWS / ft.

WATER
CONTENT, %

DRY UNIT WT
pcf

UNCONFINED
COMPRESSION,
psf

**FILL, MIXTURE OF RIPRAP, GRAVEL,
SAND, SILT, AND ASH**
Dark brown

17

5

10

13.5

550.5

WEATHERED LIMESTONE***
Light Gray

15

18

546

BOTTOM OF BORING

***Classification of rock materials has been estimated by the drill crew based on disturbed samples. Core samples and petrographic analysis may reveal other rock types.

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

*Pocket Penetrometer
**CME 140 lb. SPT automatic hammer

WATER LEVEL OBSERVATIONS, ft

WL 2 WD

WL WD

WL

Terracon

BORING STARTED 8-8-11

BORING COMPLETED 8-8-11

RIG 750 FOREMAN JG

APPROVED VER JOB # 07105081

Page 1 of 1

CLIENT

HGM Associates, Inc.

SITE

Riverside Generating Station Bettendorf, Iowa

PROJECT

Ash Containment Ponds - South Pond

Boring Location: Station 15+10

DESCRIPTION

Approx. Surface Elev.: 564 ft

**FILL, MIXTURE OF RIPRAP, GRAVEL,
SAND, SILT, AND ASH**
Dark brown

13

551

WEATHERED SANDY SHALE***

15.5

548.5

BOTTOM OF BORING

***Classification of rock materials has been estimated by the drill crew based on disturbed samples. Core samples and petrographic analysis may reveal other rock types.

DEPTH, ft.

USCS SYMBOL

NUMBER

TYPE

RECOVERY, in.

CPT AI

BLOWS / ft.

WATER
CONTENT. %

PRIMARY UNIT V

1506

COMPRESS

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

***Pocket Penetrometer**
****CME 140 lb. SPT automatic hammer**

WATER LEVEL OBSERVATIONS, ft

WL	<u>7</u>	2	WD	<u>Y</u>
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WL		
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WL	
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BORING STARTED 8-8-11

BORING COMPLETED 8-8-11

RIG	750	FOREMAN	JG
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APPROVED	VER	JOB #	07105081
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Terracon

LOG OF BORING NO. 15

Page 1 of 1

CLIENT

HGM Associates, Inc.

SITE

Riverside Generating Station
Bettendorf, Iowa

PROJECT

Ash Containment Ponds - South Pond

Boring Location: Station 17+60

GRAPHIC LOG

DESCRIPTION

Approx. Surface Elev.: 564 ft

**FILL, MIXTURE OF RIPRAP, GRAVEL,
SAND, SILT, AND ASH**
Dark brown

12

552

13

MEDIUM TO COARSE SAND

551

Dark Gray

WEATHERED SANDY SHALE***

Gray

16.5

547.5

BOTTOM OF BORING

***Classification of rock materials has been estimated from disturbed samples. Core samples and petrographic analysis may reveal other rock types.

DEPTH, ft.

USCS SYMBOL

NUMBER

TYPE

RECOVERY, in.

SPT-N
BLOWS / ft.

WATER
CONTENT, %

DRY UNIT WT
pcf

UNCONFINED
COMPRESSION,
psf

SAMPLES

TESTS

5

10

15

1

SS

10

14

17

2

SS

12

8

14

3

HS

10

8

15

SP

4

SS

18

80

13

5

SS

18

79

10

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

*Pocket Penetrometer
**CME 140 lb. SPT automatic hammer

WATER LEVEL OBSERVATIONS, ft

WL 2 WD

WL WD

WL

Terracon

BORING STARTED 8-19-11

BORING COMPLETED 8-19-11

RIG 35E FOREMAN RP

APPROVED VER JOB # 07105081

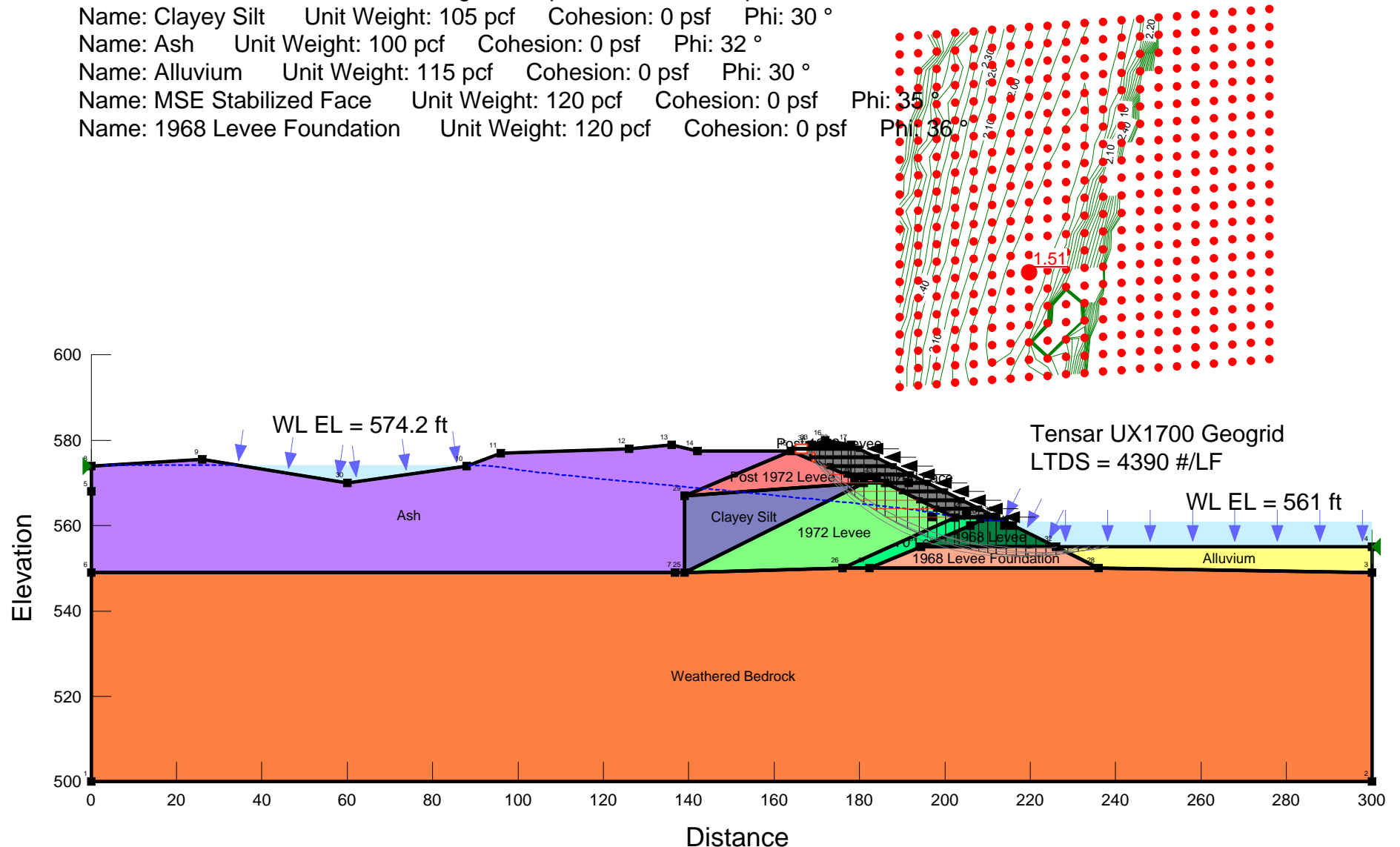
BOREHOLE BORING LOGS SOUTH POND.GPJ 2011 TULSA.GDT 9/27/11

Title: 10-ft Stabilized Face - Steady State Seepage

File Name: SECT A 10ft Stabilized w 15 ft top(Steady State) REV MSE Sep 2011.gsz

Date: 9/23/2011 By: SML

Name: 1968 Levee Unit Weight: 120 pcf Cohesion: 0 psf Phi: 38 °
Name: 1970 Levee Unit Weight: 100 pcf Cohesion: 0 psf Phi: 32 °
Name: Weathered Bedrock Unit Weight: 135 pcf Cohesion: 0 psf Phi: 40 °
Name: 1972 Levee Unit Weight: 100 pcf Cohesion: 0 psf Phi: 35 °
Name: Post 1972 Levee Unit Weight: 110 pcf Cohesion: 0 psf Phi: 35 °
Name: Clayey Silt Unit Weight: 105 pcf Cohesion: 0 psf Phi: 30 °
Name: Ash Unit Weight: 100 pcf Cohesion: 0 psf Phi: 32 °
Name: Alluvium Unit Weight: 115 pcf Cohesion: 0 psf Phi: 30 °
Name: MSE Stabilized Face Unit Weight: 120 pcf Cohesion: 0 psf Phi: 35 °
Name: 1968 Levee Foundation Unit Weight: 120 pcf Cohesion: 0 psf Phi: 36 °



Title: 10-ft Stabilized Face - Steady State Seepage

File Name: SECT B 10-ft Stabilized w 15-ft top (Steady State) REV MSE Sep 2011.gsz

Date: 9/23/2011 By: SML

Name: 1968 Levee Unit Weight: 120 pcf Cohesion: 0 psf Phi: 38 °

Name: 1970 Levee Unit Weight: 100 pcf Cohesion: 0 psf Phi: 32 °

Name: Weathered Bedrock Unit Weight: 135 pcf Cohesion: 0 psf Phi: 40 °

Name: 1972 Levee Unit Weight: 100 pcf Cohesion: 0 psf Phi: 35 °

Name: Post 1972 Levee Unit Weight: 110 pcf Cohesion: 0 psf Phi: 35 °

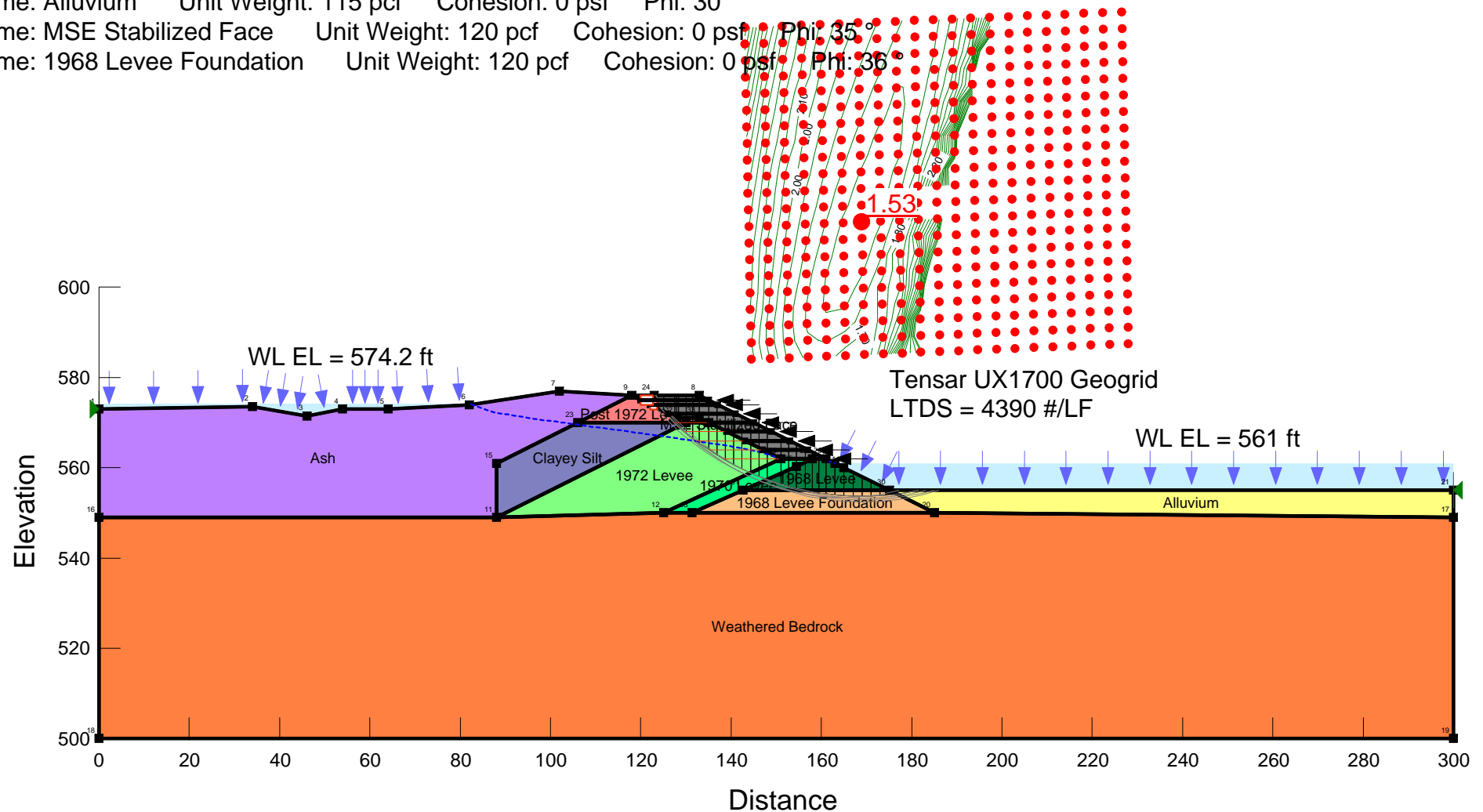
Name: Clayey Silt Unit Weight: 105 pcf Cohesion: 0 psf Phi: 30 °

Name: Ash Unit Weight: 100 pcf Cohesion: 0 psf Phi: 32 °

Name: Alluvium Unit Weight: 115 pcf Cohesion: 0 psf Phi: 30 °

Name: MSE Stabilized Face Unit Weight: 120 pcf Cohesion: 0 psf Phi: 35 °

Name: 1968 Levee Foundation Unit Weight: 120 pcf Cohesion: 0 psf Phi: 36 °

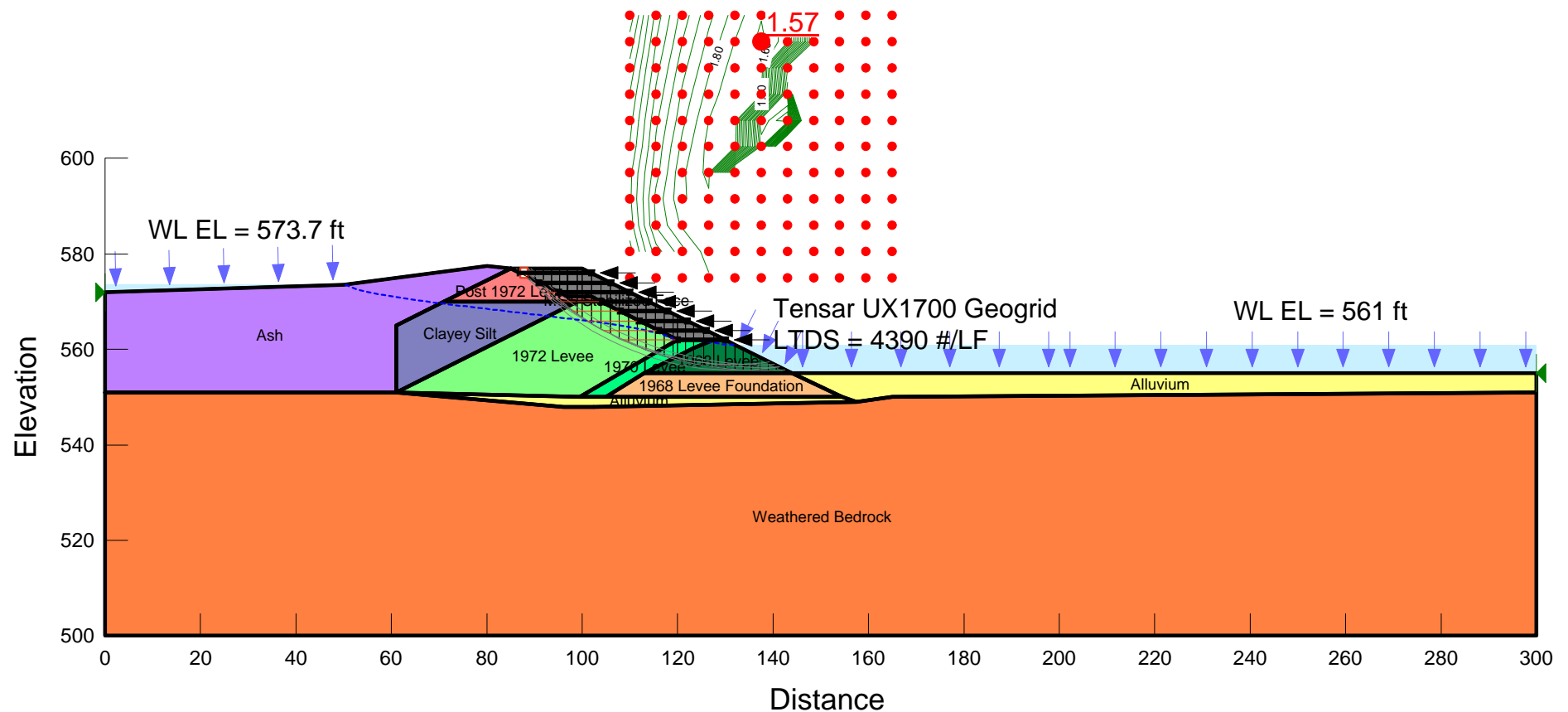


Title: 10-ft Stabilized Face - Steady State Seepage

File Name: SECT C 10-ft Stabilized w 15-ft top (Steady State) REV MSE Sep 2011.gsz

Date: 9/23/2011 By: SML

Name: 1968 Levee Unit Weight: 120 pcf Cohesion: 0 psf Phi: 38 °
Name: 1970 Levee Unit Weight: 100 pcf Cohesion: 0 psf Phi: 32 °
Name: Weathered Bedrock Unit Weight: 135 pcf Cohesion: 0 psf Phi: 40 °
Name: 1972 Levee Unit Weight: 100 pcf Cohesion: 0 psf Phi: 35 °
Name: Post 1972 Levee Unit Weight: 110 pcf Cohesion: 0 psf Phi: 35 °
Name: Clayey Silt Unit Weight: 105 pcf Cohesion: 0 psf Phi: 30 °
Name: Ash Unit Weight: 100 pcf Cohesion: 0 psf Phi: 32 °
Name: Alluvium Unit Weight: 115 pcf Cohesion: 0 psf Phi: 30 °
Name: MSE Stabilized Face Unit Weight: 120 pcf Cohesion: 0 psf Phi: 35 °
Name: 1968 Levee Foundation Unit Weight: 120 pcf Cohesion: 0 psf Phi: 36 °

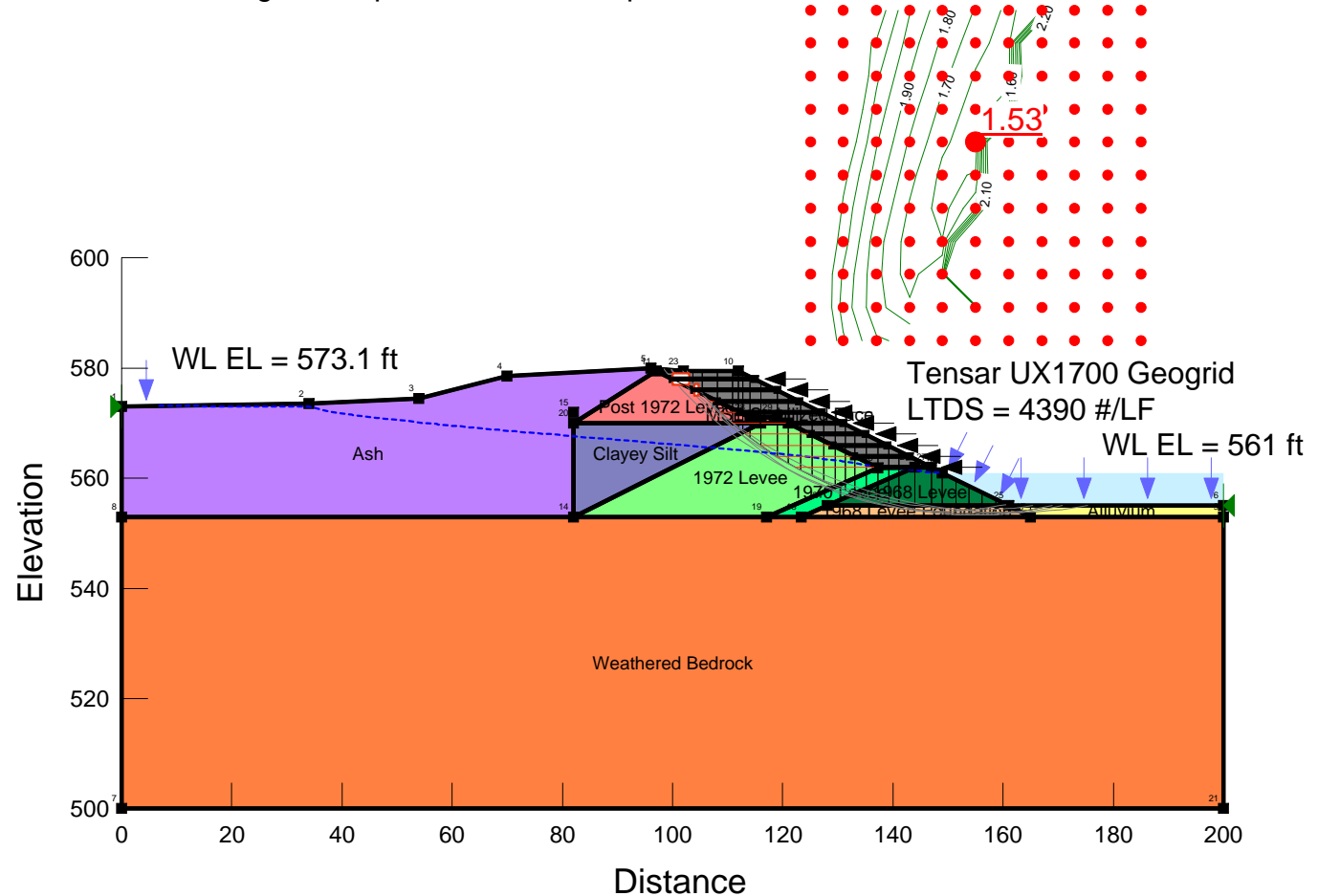


Title: 10-ft Stabilized Face - Steady State Seepage

File Name: SECT D 10-ft Stabilized w 15ft top (Steady State) REV MSE Sep 2011.gsz

Date: 9/23/2011 By: SML

Name: 1968 Levee Unit Weight: 120 pcf Cohesion: 0 psf Phi: 38 °
Name: 1970 Levee Unit Weight: 100 pcf Cohesion: 0 psf Phi: 32 °
Name: Weathered Bedrock Unit Weight: 135 pcf Cohesion: 0 psf Phi: 40 °
Name: 1972 Levee Unit Weight: 100 pcf Cohesion: 0 psf Phi: 35 °
Name: Post 1972 Levee Unit Weight: 110 pcf Cohesion: 0 psf Phi: 35 °
Name: Clayey Silt Unit Weight: 105 pcf Cohesion: 0 psf Phi: 30 °
Name: Ash Unit Weight: 100 pcf Cohesion: 0 psf Phi: 32 °
Name: Alluvium Unit Weight: 115 pcf Cohesion: 0 psf Phi: 30 °
Name: MSE Stabilized Face Unit Weight: 120 pcf Cohesion: 0 psf Phi: 35 °
Name: 1968 Levee Foundation Unit Weight: 120 pcf Cohesion: 0 psf Phi: 36 °



Title: 10-ft Stabilized Face - Steady State Seepage

File Name: SECT E 10-ft Stabilized w15 ft top (Steady State) REV MSE Sep 2011.gsz

Date: 9/23/2011 By: SML

Name: 1968 Levee Unit Weight: 120 pcf Cohesion: 0 psf Phi: 38 °
Name: 1970 Levee Unit Weight: 100 pcf Cohesion: 0 psf Phi: 32 °
Name: Weathered Bedrock Unit Weight: 135 pcf Cohesion: 0 psf Phi: 40 °
Name: 1972 Levee Unit Weight: 100 pcf Cohesion: 0 psf Phi: 35 °
Name: Post 1972 Levee Unit Weight: 110 pcf Cohesion: 0 psf Phi: 35 °
Name: Clayey Silt Unit Weight: 105 pcf Cohesion: 0 psf Phi: 30 °
Name: Ash Unit Weight: 100 pcf Cohesion: 0 psf Phi: 32 °
Name: Alluvium Unit Weight: 115 pcf Cohesion: 0 psf Phi: 30 °
Name: MSE Stabilized Face Unit Weight: 120 pcf Cohesion: 0 psf Phi: 35 °
Name: 1968 Levee Foundation Unit Weight: 120 pcf Cohesion: 0 psf Phi: 36 °

